भारतीय मानक
Indian Standard

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सामान्य प्रयोजन तथा औद्योगिक अनुप्रयोगों हेतु वायु स्क्रू संपीड़को (तेल-प्लावित) के लिए तकनीकी आपूर्ति अवस्था

(पहला पुनरीक्षण)

Technical Supply Condition for Air Screw Compressors (Oil-Flooded) for General Purpose and Industrial Applications

(First Revision)

ICS 23.140

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June 2023 **Price Group 6**

Compressor, Blowers and Exhausters Sectional Committee, MED 22

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Compressor, Blowers, and Exhausters Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1987. This standard is being revised again to keep pace with the latest technological developments and international practices. In this revision, the following major changes have been made:

a) A reference clause has been added mentioning the latest version of all the referred standards; and
b) Clauses **5.1.5**, **7.4**, and **7.6** have been modified.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

TECHNICAL SUPPLY CONDITION FOR AIR SCREW COMPRESSORS (OIL-FLOODED) FOR GENERAL PURPOSE AND INDUSTRIAL APPLICATIONS

(First Revision)

1 SCOPE

1.1 This standard covers the minimum requirements for air screw compressors (oil-flooded type) for general purpose and industrial applications using prime movers up to 370 kW.

1.2 The standard does not cover the mobile air screw compressors, dry (oil-free) screw compressors, air conditioning and refrigeration screw compressors.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to the agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
IS 919 (Part 1) : 2014/ ISO 286-1 : 2010	Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes (*third revision*)
IS 2825 : 1969	Code for unfired pressure vessels
IS/ISO 3857-2 : 1977	Compressors, pneumatic tools and machines — Vocabulary: Part 2 Compressors
IS 4503 : 1967	Specification for shell and tube type heat exchangers
IS 5456 : 2006	Testing of positive displacement type air compressors and exhausters — Code of practice (*second revision*)

3 TERMINOLOGY

For the purpose of this standard, definitions as given in IS/ISO 3857-2 shall apply.

4 ENQUIRY AND PROPOSAL

4.1 Enquiry

The purchaser shall complete the data as given in Annex A to the extent possible and applicable, and also specify the known abnormal conditions of workings. In addition, the purchaser may also specify any of his additional requirements.

4.2 Proposal

In reply to the enquiry by the purchaser, the supplier shall supply a list of all the components and accessories along with any other details required by the purchaser.

4.2.1 The proposal shall include either a specific statement that all equipment are in strict compliance with the purchaser's specifications or a specific list of deviations therefrom shall be furnished.

4.2.2 If required by the purchaser, the charges for deputing the supplier's representative for supervision of erection shall be furnished.

4.2.3 The supplier shall furnish any special tools required for installation and maintenance work at additional charges.

4.3 Guarantee

4.3.1 *Performance Guarantee*

The compressors shall be guaranteed for satisfactory performance at the specified operating conditions. These include a guarantee for capacity and power at the time of the performance test. The tolerances to be allowed on the capacity and power consumption shall be in accordance with IS 5456.

4.3.2 *Workmanship Guarantee*

All equipment, components and spare parts, other than bought-out components, shall be guaranteed by the supplier against manufacturing defects which arise from defective or improper materials or poor and faulty workmanship. This guarantee shall be applicable for a period of 12 months from the date of supply or 2 000 working hours from the date of installation of the compressor, whichever is earlier. If any defects or malperformance is established during the guaranteed period, the supplier shall make all necessary or desirable alterations, repairs and replacements free of charge.

5 GENERAL REQUIREMENTS

5.1 Parts subjected to air pressure shall have sufficient strength.

5.1.1 If an electrical prime mover is used, proper earthing shall be ensured by the agency responsible for the installation of compressors.

5.1.2 Every part shall have interchangeability and shall be ensured, while manufacturing, to avoid any deviation in the performance of the compressor.

5.1.3 Generally parts shall be manufactured to ‘fits and tolerances’ of IS 919 (Part 1) which ensure the proper functioning of compressors.

5.1.4 Manufacturer shall reserve the right to make modifications reflecting improvements in performance/life of the compressor. This shall not affect the guarantee mentioned in **4.3.1** and **4.3.2**.

5.1.5 Maximum allowable working pressure shall exceed the rated discharge pressure by at least 10 percent or 1 bar, whichever is greater, but shall be lower than the safety valve set pressure.

5.2 Materials

5.2.1 *Casing and Bearing Housing*

The thickness of the casing and bearing housing shall be adequate and suitable for maximum design working pressures.

5.2.2 The casing jacket cooling, whenever provided, shall be designed to prevent any leakage of gas into the coolant.

5.2.3 Compressor housing shall have a built-in oil sump of adequate capacity or a separately provided container depending upon the design aspects.

5.3 Rotors

5.3.1 Rotors shall be of forged steel, rolled bar or cast iron materials depending upon the design aspects and physical size to screw compressors. These may be single-piece or two-piece construction of similar materials. In the case of smaller rotors, two different materials may be used for constructing rotor assembly, enabling the use of non-ferrous and polymers.

5.3.2 Normally, by and large (4 + 6) lobe arrangement is accepted by various manufacturers but this shall also be with other lobe combinations depending upon the specific design.

5.4 Valves and Filters

5.4.1 Receiver-cum-oil separator shall be provided with a safety valve to prevent abnormal pressure rising and to ensure the safety of the unit.

5.4.2 Suitably designed inlet control valves shall be provided so that they operate smoothly, free from malfunctioning and rusting, etc.

5.4.3 Suction air filters shall be selected such that they offer minimum resistance to suction and shall be effective for dust prevention.

5.5 Air/Oil separation system shall be provided to form an integral part of the operational package with replaceable separation element.

5.5.1 The oil separator system shall be redesigned so that the oil carry over through discharge air shall not exceed 1 litre per cubic metre per 100 h. This shall be termed oil consumption and the measurement of oil consumption shall be carried out as mentioned in IS 5456.

5.5.2 The vessel used to accommodate oil and separator elements shall conform to IS 2825.

5.6 Cooling System

An efficient cooling system for oil/air shall be provided such that lubricating oil/air temperature shall be maintained within the limits specified by the manufacturer.

5.7 Lubrication System

It shall consist of a built-in oil reservoir with compressor housing or a separator oil filter, with or without the built-in by-pass valve, injection port and hoses connecting the oil cooler compressor housing, ideally the control system shall be such when restriction covered by filter exceeds present limits, the compressor shall stop. However, when the situation demands, the filter shall be provided with the by-pass valve so that compressor is not stopped till such time the filter element is changed. The circulation of oil may be arranged by a separate electric motor or the drive may be taken from either rotor shaft extension. The oil reservoir capacity shall be such that it stores an adequate amount of lubricating oil which circulates through the closed-loop system. It is important that oil temperature at the acceptable minimum level and acceptable maximum level shall be maintained so that condensation is not separated out at a minimum temperature within the oil system and also to ensure the discharge air temperature shall not run very high at maximum temperature since it is a close oil system.

5.8 Lubricating Oil

The manufacturer shall recommend a proper lubricating oil considering the operating conditions based on the information provided by the purchaser.

6 PRIME MOVER AND DRIVE EQUIPMENTS

The supplier shall specify the type of prime mover/drive in the enquiry according to Annex A.

6.1 Prime Mover

6.1.1 *Electric Motor*

Serving as the main driver, shall be of continuous rating. It shall have minimum at 5 percent margin over power required by the compressor under the rated operating conditions considering the tolerances as specified in IS 5456.

6.1.2 Electric motor shall have enough starting torque to be able to start compressor from rest to the full load running condition under specified starting system, for example, direction line, star delta, autotransformer, etc.

6.1.3 Proper earthing shall be ensured as agreed to between the manufacturer and the purchaser.

6.2 Internal Combustion Engine

6.2.1 The purchaser shall specify the expected duty to which compressor shall operate to enable the manufacturer to select proper sized engine.

6.2.2 The manufacturer shall ensure that the engine shall have minimum 5 percent margin over the power required by the compressor under any operating condition after taking into account site conditions specified by the purchaser.

6.2.3 The manufacturer shall select the coupling after analysis of the system and considering variable speed.

6.2.4 The engine selected shall be a governed engine and the governing class shall be selected based on the duty specified by the purchaser.

7 AUXILIARY EQUIPMENT

7.1 Coolers

The purchaser shall specify the air discharge temperature required to enable the manufacturer to provide a suitable cooler. The cooler shall conform to IS 4503.

7.2 Air Receiver

The receiver, whenever supplied, shall conform to IS 2825. This is an additional receiver than provided as an oil separator with the package.

7.3 Guards

7.3.1 Guards shall be of removable type provided on all movable parts which are considered to be hazardous to opening personnel.

7.3.2 If guards are not easily removable type, an opening (if necessary with covers or suitable mesh) shall be provided to have access to any part requiring attention.

7.3.3 When the belt-driven compressor is considered, the belts shall be selected to transmit the maximum shaft power of the compressor. The belt drive design shall also be suitable for the same and appropriately be provided with the guard. The slide rails used under the motor for taking up belt slackness (after some running of the unit) shall be selected such that it provides enough room for tightening.

7.4 Silencer

7.4.1 The purchaser shall specify the required noise level of the unit or as applicable by state regulations.

7.4.2 The manufacturer shall provide the silencer to limit noise level according to the agreement.

7.5 Piping

7.5.1 The pipe work required with the compressor, when given as a package (with the receiver or with the base plate), shall consist of:

a) Air piping (hose or metallic type) for final discharge, that is, compressor to after-cooler (if after cooler is a part of supply); and
b) Auxiliary pipe work-oil cooler to compressor (depending upon compressor design) hose or metallic type, drain and vent and instrument air.

7.5.2 The scope of supply of pipe work by the supplier shall be properly defined with terminal points clearly fixed. The supplier shall supply all pipe work to interconnected items of his supply reducing the number of terminal points for the purchaser’s connection, to a minimum when the scope of supply shall be mutually agreed upon.

7.5.3 Auxiliary pipe work, that is, oil cooler to compressor, drain, vent and instrument air shall be suitably fixed on the package.

7.5.4 Unless otherwise specified, the supplier shall supply the pipe work of his choice.

7.6 Instrumentation and Safety Device

Following instrumentation shall be provided by the manufacturer:

a) Delivery pressure gauge;
b) Lubricating oil pressure gauge;
c) Lubricating oil/air delivery temperature gauge;
d) Hour meter for recording running hours;
e) Safety valve on air/oil separator vessel;
f) Differential pressure gauge for lubricating oil filter (optional);
g) Differential pressure gauge for oil separator elements (optional);
h) High lubricating oil temperature safety switch;
j) High air discharge pressure safety switch (optional);
k) Clogging indicator for air suction filter;
m) Low water pressure safety switch (if water coolant systems are used); and
n) High cooling water temperature safety switch (if a water coolant system is used).

Additional instruments for electric-driven compressors shall be provided as per the agreement between the manufacturer and buyer.

8 CONTROLS

8.1 Automatic start-stop mode of operation makes or breaks electric contact to the motor at predetermined pressures. This type of regulation shall be used when the demand for air is small or intermittent, but where pressure shall be continuously maintained.

8.2 Constant speed mode of operating unloads the compressor at predetermined pressure while the the motor continues to operate. This type of regulation shall be used when the demand for air is practically constant at the capacity of the compressor.

8.3 Dual control permits a normal selection between constant speed control and automatic start/ stop control, depending upon the air requirements.

9 NAME PLATE AND ROTATION ARROW

9.1 Name plate shall be securely attached at an easily accessible point on the compressor and to any other major auxiliary equipment.

9.2 Rotation arrow shall be cast in or attached to the major item of rotating equipment.

10 TESTS ON COMPRESSORS

10.1 The tests, other than hydrostatic and pressure tests, shall be in accordance with the manufacturer's requirements unless otherwise specified.

10.2 Air receiver (when supplied) and cooler shall be subjected to the hydrostatic test pressure of 15 times the design pressure or in accordance with the specified requirements.

11 PREPARATION FOR DISPATCH

11.1 After the test and inspection are completed, all exposed machined surfaces shall be coated with suitable rust preventive.

11.2 Unmachined external surfaces shall be cleaned thoroughly and painted with a suitable paint.

11.3 All openings shall be provided with plastic or metal closures.

12 DOCUMENTATION

12.1 The following data and drawings shall be furnished by the supplier, in addition, any other documentation mutually agreed between the purchaser and the supplier before placement of the the order shall be furnished.

12.1.1 Manufacturers shall provide data as required by the data sheet given in Annex A along with deviations and exceptions, etc.

12.1.2 Overall arrangement, drawing of the compressor, prime mover and other accessories shall be provided. The drawing shall also show the following:

a) All principal dimensions, including those required for purchasers foundations and maintenance, and withdrawal space;
b) The direction of rotation of the drive shaft; and
c) Position of foundation bolts.

12.1.3 If the prime mover is not included in the supply, the relevant data for the prime mover shall be supplied.

12.1.4 Schematic drawing of the control system, when required and not covered in maintenance and operating instruction book, cooling system and outline dimensional drawing for accessories such as after cooler and instrument panel, make, type, size, etc, shall be indicated for all these accessories.

12.1.5 *Maintenance and Operating Instructions*

The manufacturer shall supply the literature, such as the user handbook (operating manual), part identification manual and maintenance manual to the purchaser.

12.1.6 Certificate for pressure vessels to which these are designed and manufactured shall be issued.

12.1.7 Material certificates for materials used in the manufacture of the compressor and all test reports for mechanical, performance tests and other tests shall be supplied, as mutually agreed between the supplier and the purchaser.

12.1.8 Required data for ordering spare parts shall be furnished.

12.1.9 The number of copies for drawings and documents shall be mutually agreed between the purchaser and the supplier.

ANNEX A

(*Clauses* 4.1, 6 *and* 12.1.1)

DATASHEET CONTAINING PURCHASER'S SPECIFICATIONS

A-1 GENERAL

- a) No. of units — Running/standby;
- b) Site;
- c) Service — Continuous/intermittent;
- d) Installation — Indoor/outdoor with roof/outdoor without roof;
- e) Type of driver — Electric motor/diesel engine/petrol engine;
- f) Prime mover furnished by purchaser/supplier; and
- g) Used as portable/stationary.

A-2 REQUIRED OPERATING CONDITION

- a) Site Data
  - 1) Barometric pressure;
  - 2) Relative humidity; *Max*
    Min
  - 3) Ambient temperature, at the filter;
    Max
    Min
  - 4) Environmental condition — Clean/very dusty/in any unusual corrosive atmosphere;
  - 5) Any special electrical equipment required because of hazard
    Class ……………………………….
    Grade …………………………….
    Division ……………………………;
  - 6) Cooling water supply for coolers — Type of water, pressure and temperature of supply and return (if applicable);
- b) Electrical supply characteristics (required, if the prime mover is a motor);
- c) Capacity required (each machine);
- d) Discharge pressure; and
- e) Discharge temperature required (specify only if after-cooler is required).

A-3 CAPACITY CONTROL

- a) For maintaining air receiver pressure at — kg/cm^2, this shall be done by;
  - 1) Suction valve unloader;
  - 2) ……………………… start/stop; and
- b) Any other requirements.

A-4 SPECIAL REQUIREMENTS

- a) Maximum allowable speed (rpm) at prime mover shaft;
- b) Special materials;
- c) Type of filter for air;
- d) Design code for air receiver and heat exchanger;
- e) Standard to which prime mover shall conform;
- f) Transmission — V-Belt
  Flat belt
  Belt box
  Direct or drive; and
- g) Any special type of couplings.

A-5 SCOPE OF SUPPLY

- a) Prime mover;
- b) Additional instrumentation;
- c) Additional safety devices;
- d) After-cooler;
- e) Air receiver;
- f) Safety valves-compressor, receiver;
- g) Air filter, lube filter, separation system;
- h) Cooling water piping for alter-coolers (if applicable);
- j) Instrument panel;
- k) Special tools;
- m) Spare parts and operations manual;
- n) Foundation plane (if applicable); and
- p) GAD-auto and manual compressor de-pressurization on shutdown.

A-6 INSPECTION AND TESTS

- a) Shop inspection required;
- b) Test to be withstood;
- c) Hydro test of the compressor housing;
- d) Mechanical run test;
- e) Performance test;
- f) Strip test; and
- g) Run test of the prime mover (if applicable) (at supplier's end).

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Compressor, Blowers and Exhausters Sectional Committee, MED 22

Organization	*Representative(s)*
Bharat Petroleum Corporation Limited, Mumbai	Shri K. Ravi **(*Chairperson*)**
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